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REVIEWS.

Expedicion Cientifica al Popocatapetl. JOSE G. AGUILERA Y EZEQUIEL ORDOÑEZ. Mexico, 1895. 8vo, 48 pp., 6 plates and 2 charts. Published by the Geological Commission of Mexico.

THE volcano, to a description of which this pamphlet is devoted, is perhaps the most widely known of any in the Western Hemisphere. From the time of Cortez to the present, its towering height and condition of semi-activity have made it a subject of continual interest. Yet the descriptions of it so far published have, from a scientific point of view, been meager and fragmentary. Humboldt in his work on Mexico makes but brief mention of it. Later travelers, notably Felix and Lenk, have added much to our knowledge of the mountain, but their accounts have failed to give sufficient data to permit intelligent comparison of its characters with those of other great volcanoes.

It is, therefore, a real service to the science of geology which the authors of this pamphlet have done, in preparing so comprehensive and careful a description of the features of Popocatapetl. While full recognition is made of the work of previous observers, the larger part of the data are original with the authors themselves. So comprehensive, moreover, is the treatment of the subject that future study of the volcano may profitably be confined to special portions or phases of its structure.

The work begins with a description of the orographic relations of the volcano, it being shown that it forms the most southern and highest part of the Sierra which separates the valley of Mexico from the valley of Puebla. The form of the volcano is stated to be that of an elliptical cone whose major axis has a northwest-southeast direction. The cone is formed of three parts, the upper, covered by a mantle of perpetual snow, and hence having a uniform slope, the median, composed of sands whose surface is cut by radiating channels made by the flow of waters from above, and the lower, which is part of the highly irregular and tortuous fold of the Sierra. Several great barrancas or ravines made by the flow of waters from above cut the lower portion of the cone and modify somewhat its relief. They take their origin in semicircular depressions of the cone which have a more or less crateriform aspect. The most notable of these is that at the head of the Barranca del Fraile. It cuts a great amphitheater-like section out of the northwest flank of the mountain and is surmounted by a peak known as the Pico del Fraile.

This great depression has usually been regarded as an old crater, but in the view of the authors it is simply a cavity cut in the mountain by atmospheric and stream erosion. Their reason for this view is that the slope of the strata of lava is everywhere uniform with that of the major cone. Had the lava exuded from this point they argue, the slope of the layers would have been away from the crater on all sides.

The form of the crater at the summit of the mountain is that of an elliptical cylinder resting upon an inverted cone.

Its greatest depth is 1640 feet (505 meters), greatest diameter 1988 feet (612 meters) and least diameter 1299 feet (400 meters). These determinations, especially that of the depth, differ considerably from those made by previous observers. The form of the crater, the authors state, was probably originally that of an inverted cone. Their explanation of its present form is that by the accumulation of material dislodged from its walls, the interior has been filled up and the outer border extended till the interior walls are now nearly vertical.

In regard to its structure, Popocatapetl is classed with the volcanoes known as stratified, on account of the resemblance to sedimentary formations presented by the succession of currents of lava of which it is made up.

In the character of the lava of these successive outflows, a marked gradation can be traced, corresponding to a gradual decrease in the heat and energy of the volcano. The lavas of the lower currents are granular, devitrified and of trachytic structure; those of the upper currents, vitreous, of resinous luster and amorphous structure with a few phenocrysts. The difference in structure is ascribed to the fact that the upper currents being farther from the source of heat were more nearly cooled when poured out and became solid before time sufficed for crystallization.

A difference in mineralogical composition between the upper and lower lavas is also noticeable; the lower lavas are basalts containing a large amount of olivine; the upper, hypersthene andesites.

Considering the products of the volcano as a whole, the life of the volcano can be divided into three periods, indicating a gradual decrease in its heat and energy. These may be denominated the period of lava eruptions, the period of breccia eruptions and the period of eruptions of ashes.

Between the successive outflows of the first period, varying intervals of time intervened. During the intervals the surface of the outflow became covered with masses of cooled and broken lava which were cemented by the next outflow into a breccia. These layers of breccia are prominent through the lavas and serve to mark the boundaries of each outflow.

During the second period of the life of the volcano, solid material was ejected in the form of bombs, blocks of lava and pumice. These were more or less assorted by running water and consolidated by argillaceous and ferruginous cements. Their character and relative position may now readily be studied in the Barranca of Tlamacas.

During the last period of the life of the volcano, the coarse, black sands or ashes which cover the surface of the upper part of the cone were extruded. These have been moved about by winds and waters till now they are deposited over the surface of the cone in masses of very unequal thickness. Between these deposits are intercalated thin lenses of alluvium, indicating periods of repose in this phase of the volcanic activity as well.

Attention is called to the similarity of the material poured forth by the volcano to that produced by eruptions in the valley of Mexico, and on this fact is based a suggestion as to the age of the lavas. In the latter place, the first eruptions of hypersthene andesites are covered by sediments in which are found remains of *equus*, *cariacus*, *elephas*, etc., showing that the eruptions must have taken place in the early Pliocene.

The early eruptions of Popocatapetl which produced olivine basalts are believed to have been contemporaneous with these, inasmuch as they underlie andesitic lavas similar to those of the Santa Catarina volcano. The lavas of the latter mountain are known to have been ejected at the time when the Pliocene sediments were forming over the valley of Mexico, hence the andesite lavas of Popocatapetl may be regarded as late Pliocene in age.

Attention is called to the fact that in this same region, volcanoes within very short distances of one another were producing at the same time, the one basalts, the other andesites. The practical contemporaneity of the outflows is proved by the fact that beneath the lavas of each have been found human skulls and evidences of human industry.

The occurrence is paralleled in modern times by the outflows of Jorullo and Colima. The lavas of the former are basalts, of the latter, andesites.

The last pages of the work are devoted to a succinct description of the three types of rocks which go to make up the volume. They are classified as labradorite basalts, hypersthene andesites, either with or without augite, and trachytes.

The height of the volcano is given as 17,701 feet (5450 meters).

Observations made by the present writer during a recent visit to the volcano, in general go to substantiate the views presented in the work under discussion. He can, however, hardly agree with the authors in regarding the formation of all the vertical surfaces of the mountain as the result of erosion.

It is especially difficult to understand how the walls of the crater could have become vertical in this way. The degradation of cliffs to form slopes is a phenomenon of common occurrence, but that the reverse can take place seems exceedingly doubtful.

The vertical walls of the crater seem to the writer rather to give evidence of the character of the force which produced the latest eruptions. It was an upward force, bringing up from below broken lavas and ashes. As the force was sufficient to send these many miles away from the volcano, it is not unreasonable to suppose that it was sufficient to break through and remove the lavas in the crater. Thus would be left a conduit with vertical walls, the only effect of subsequent erosion upon which would be that of degradation. That this is the process going on at the present time, a short stay in the crater makes evident.

It seems much more probable that the walls of the so-called old crater may have been formed, as the authors suggest, by a process of erosion, yet their statement of the mode of formation is hardly satisfactory.

Another feature of the volcano which the authors explain as the result of erosion, seems to the writer to have had a different origin. This is the assemblage of lavas at the point called La Cruz. Here the lava lies in great ridges which jut out prominently from the slope of ashes which cover the cone. Since these lavas are similar to those found in the crater, the authors regard them as vestiges of the latest flow, from which the areas connecting them with those above have been removed by erosion. The lineal character of the ridges, however, and their prominence, seem to the writer sufficient evidence for regarding them, as is usually done, lateral outbursts through the side of the cone.

The work is illustrated by several fair plates giving sketches of portions of the volcano. The employment of photographs for purposes of illustration would have been, however, more satisfactory.

OLIVER C. FARRINGTON.

RECENT WORK ON THE CARBONIFEROUS OF KANSAS.

Stratigraphy of the Kansas Coal Measures, by ERASMUS HAWORTH, Kansas Univ. Quart., Vol. III, pp. 281–295, 1895.

Classification of the Upper Palæozoic Rocks of Central Kansas, by CHAS. S. PROSSER. Journal Geology, Vol. III, pp. 682–705 and 764–800, 1895.

Permian System of Kansas, by F. W. CRAGIN. Colorado College Studies, Vol. VI, pp: 1–48, 1896.

A generation ago the upper Carboniferous succession in Kansas was the subject of prolonged and ofttimes somewhat acrimonious discussion. Since the close of that memorable debate there has been until very recently very little investigation undertaken in the state. So, for more than a quarter of a century practically nothing has been done to clear up the doubt concerning the question of the natural subdivisions of the Carboniferous system of that region ; and for the same period little attempt has been made to decipher the stratigraphy of the formations which constitute the whole eastern third of the state.

Of late, within a few months of one another, three important memoirs have appeared which have greatly extended our knowledge of the stratigraphy of the region. These contributions, primarily to Kansas geology, are by Dr. Erasmus Haworth, Professor Charles S. Prosser, and Professor F. W. Cragin. The work along the three lines being undertaken without regard to one another the results are in no way directly connected. While this method of treatment has the